CLAIMS

1. A method for controlling movement of individual hydraulically moveable ends of a screed head carried by a machine so as to maintain a selected elevational position between each end of the screed head and an elevational reference in a concrete paving application, comprising:

providing a control system controlling the hydraulically moveable ends of the screed head;

providing a pair of laser receivers and a gravity-based cross slope sensor to the screed head and in communication with the control system;

setting the pair of laser receivers in an appropriate dead band with the elevational reference; and

using the gravity-based cross slope sensor when one of the laser receivers loses reception of the elevational reference to provide a relative measurement of the interrupted laser receiver which, when coupled with an absolute measurement of the uninterrupted laser receiver, provides an estimate of the absolute position of the interrupted laser receive, the control system using the provided absolute and estimated absolute positions to control the elevation of the hydraulically moveable ends of the screed head.

2. The method of claim 1, further comprising:

measuring a desired grade with the gravity-based cross slope sensor; and

storing the desired grade in memory of the control system.

3. A control system for controlling movement of individual hydraulically moveable ends of a screed head carried by a boom of a machine so as to maintain a selected elevational position between each end of the screed head and a reference in a concrete paving application as the screed head is moved toward the machine, comprising:

an elevation receiver, mounted on a first end of the screed head, providing a first signal indicating the position of the first end of the screed head in relation to the reference;

an elevation receiver, mounted on a second end of the screed head, providing a second signal indicating the position of the second end of the screed head in relation to the reference;

a sensor, mounted on the screed head, for sensing slope of the screed head along its length from the first end to the second end and providing a third signal indicating said slope; and

a control circuit, responsive to the elevation receivers and to the sensor, for controlling the hydraulically moveable ends of the screed head using the first and second signals from the elevation receivers when the first and second signals are available, and for controlling the hydraulically movable ends of the screed head using the third signal from the sensor and one of the first and second signals from the elevation receivers when the other of the first and second signals is not available.

4. The control system according to claim 3 for controlling movement of individual hydraulically moveable ends of a screed head carried by a boom of a machine so as to maintain a selected elevational position between each end of the screed head and a reference in a concrete paving application as the screed head is moved toward the machine, in which the control circuit

maintains the screed head in an orientation such that the third signal remains substantially constant when one of the first and second signals from the elevation receivers is not available, whereby the orientation of the screed head along its length from the first end to the second end also is maintained substantially constant.

5. The control system according to claim 3 for controlling movement of individual hydraulically moveable ends of a screed head carried by a boom of a machine so as to maintain a selected elevational position between each end of the screed head and a reference in a concrete paving application as the screed head is moved toward the machine, in which the sensor is an inclinometer mounted on the screed head.

6. The control system according to claim 5 for controlling movement of individual hydraulically moveable ends of a screed head carried by a boom of a machine so as to maintain a selected elevational position between each end of the screed head and a reference in a concrete paving application as the screed head is moved toward the machine, in which the inclinometer is a pendulum sensor with a low pass filtered output.

7. The control system according to claim 3 for controlling movement of individual hydraulically moveable ends of a screed head carried by a boom of a machine so as to maintain a selected elevational position between each end of the screed head and a reference in a concrete paving

application as the screed head is moved toward the machine, in which the receivers are light detectors, and in which the reference is established by a beam of light.

8. The control system according to claim 3 for controlling movement of individual hydraulically moveable ends of a screed head carried by a boom of a machine so as to maintain a selected elevational position between each end of the screed head and a reference in a concrete paving application as the screed head is moved toward the machine, in which the receivers are laser light detectors and in which the reference is established by a beam of laser light.

9. A control system for controlling movement of individual hydraulically moveable ends of an elongated tool so as to maintain a selected elevational position between each end of the tool and a reference, comprising:

an elevation receiver, mounted on a first end of the tool, providing a first signal indicating the position of the first end of the tool in relation to the reference;

an elevation receiver, mounted on a second end of the tool, providing a second signal indicating the position of the second end of the tool in relation to the reference;

a sensor, mounted on the tool, for sensing slope of the tool along its length from the first end to the second end and providing a third signal indicating said slope; and

a control circuit, responsive to the elevation receivers and to the sensor, for controlling the hydraulically moveable ends of the tool using the first and second signals from the elevation receivers when the first and second signals are available, and for controlling the hydraulically

movable ends of the tool using the third signal from the sensor and one of the first and second signals from the elevation receivers when the other of the first and second signals is not available.

10. The control system for controlling movement of individual hydraulically moveable ends of an elongated tool so as to maintain a selected elevational position between each end of the tool and a reference according to claim 9, in which the sensor is an inclinometer mounted on the tool.

11. The control system for controlling movement of individual hydraulically moveable ends of an elongated tool so as to maintain a selected elevational position between each end of the tool and a reference according to claim 9, in which the control circuit maintains the tool in an orientation such that the third signal remains substantially constant when one of the first and second signals from the elevation receivers is not available, whereby the slope of the tool along its length from the first end to the second end also is maintained substantially constant.

12. The control system for controlling movement of individual hydraulically moveable ends of an elongated tool so as to maintain a selected elevational position between each end of the tool and a reference according to claim 9, in which the sensor is a pendulum sensor with a low pass filtered output.

13. A method of controlling the elevational position of hydraulically moveable ends of a tool in relation to a reference detected by elevation receivers attached to the ends of the tool, said method comprising:

(a) selecting a desired elevational position of the tool with respect to the reference;

(b) sensing with the elevation receivers the position of the ends of the tool in relation to the reference;

(c) sensing slope of the tool along its length from one end to the other; and

(d) controlling the elevational positions of the ends of the tool using the sensed positions of the ends of the tool in relation to the reference when such positions are both known, and when reception of at least one of the elevation receivers of the reference is interrupted, controlling the elevational positions of the ends of the tool using the sensed position of one of the ends of the tool and the sensed orientation of the tool along its length from one end to the other when such positions are not both known.

14. The method of controlling the elevational position of hydraulically moveable ends of a tool in relation to a reference detected by elevation receivers attached to the ends of the tool, when reception of one of the elevation receivers of the reference is interrupted, according to claim 13, further comprising the steps of:

(e) detecting lateral movement of the tool generally in the direction of the length of the tool; and

(f) discontinuing controlling the elevational positions of the ends of the tool using the sensed orientation of the tool until the lateral movement of the tool generally in the direction of the length of the tool is terminated.

15. The method of controlling the elevational position of hydraulically moveable ends of a tool in relation to a reference detected by elevation receivers attached to the ends of the tool, when reception of one of the elevation receivers of the reference is interrupted, according to claim 13, in which the step of sensing slope of the tool along its length includes using an inclinometer.

16. The method of controlling the elevational position of hydraulically moveable ends of a tool in relation to a reference detected by elevation receivers attached to the ends of the tool, when reception of one of the elevation receivers of the reference is interrupted, according to claim 13, in which the elevation receivers are light detectors and in which the reference is a rotating beam of light.

17. The method of controlling the elevational position of hydraulically moveable ends of a tool in relation to a reference detected by elevation receivers attached to the ends of the tool, when reception of one of the elevation receivers of the reference is interrupted, according to claim 13, in which the elevation receivers are laser light detectors and in which the reference is a rotating beam of laser light.